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(54) CENTRAL VENOUS CATHETER SYSTEM

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ABSTRACT

A system of applying a central venous catheter by puncture includes a valve having a catheter and a flexible extension tube sealingly connected to the catheter. The free end of the tube may be located on a level essentially below the level of the valve catheter and is carrying a sealingly connected several - way valve. The latter valve has at least two connections for the connection of a venous pressure meter. The system also has at least one dropping supplying means and/or at least one injection syringe. The catheter is made of thin flexible material and is rigidly mounted to the outlet of a one-way valve. A withdrawable cannula extends through the one-way valve and catheter, the tip of the cannula projecting outside the tip of the catheter.

The present invention refers to a system for the application of a central venous catheter preferably by puncturing of vena subclavia in the human body.

Essential advantages are involved in the method of administration of liquid and nourishment into the patient through a central venous catheter means for instance applied in vena subclavia. Such a venous catheter means is suitably applied when measuring the central venous pressure,which gives an indication of the liquid status of the human body in connection to administration of liquid or nourishment into the patient in large amounts or during long periods or when frequently taking venous samples.

In spite of the obvious advantages of applying a central venous catheter means this method has not become commonly used due to certain problems and disadvantages in known venous catheter systems. The problems of applying a central venous catheter by puncture of vena subclavia is mainly based on the fact that there is a sub-pressure present in vena subclavia, and therefore the risk of drawing air into the patient with subsequent air embolies is always to be considered. When puncturing vena subclavia or changing infusion substance or accessories it is therefore of the greatest importance that this is done while keeping in mind the sub-pressure that is present in the vein and in the venous catheter system.

A known venous catheter system comprises an infusion cannula having a catheter means which is mounted in sealed relationship in an adapter formed with a through bore, and in which a cannula may be introduced so as to extend somewhat outside the catheter with the tip thereof. When puncturing vena subclavia the patient is placed in a particular position, whereupon the cannula is filled with a suitable liquid by means of a syringe, and at the same time as the vena subclavia is punctured blood is drawn into the syringe, and then the cannula is drawn out at the same time as the outlet is closed so that no air is allowed to enter the catheter. The catheter and the adaptor are attached directly to the chest of the patient with the aid of tape or the like. When now the venous pressure is to be measured or liquid or nourishment is to be administrated into the patient a flexible tube is connected directly

between the venous pressure gauge or the bottle of liquid or nourishment and the venous catheter, whereby all air is as usually carefully removed from the connection point. It may be noted that only one connection may be established at the time. When providing this connection the venous catheter will irrevocably be rotated or turned, which may cause the patient pain and provide a risk that the catheter which is usually made of a thin plastic material is broken and thereby becomes unfit. There is also an obvious risk that air is sucked into the vein due to the existing sub-pressure in said vein. This is also the case when changing the situation from measuring the venous pressure to infusing some substance. Further there is also always a risk of infection when working close to the point of puncture. This is also the case when an injection is to be given via the central venous catheter by means of a syringe.

In order to avoid to some extent the disadvantages of the previously known venous catheter means having an adaptor, the adaptor has been replaced by a one-way-valve or a three-way-valve having two outlets, whereby two different accessories may be connected to the venous catheter means, for instance a venous pressure meter to one of the outlets and a liquid or nourishment pipe to the other outlet. The risk of introduction of air is however possibly still greater with the three-way-valve means than with the previous embodiment, and the risk of buckling of the catheter when turning the adjustment tap of the three-way-valve is as great as previously and so is the risk of contamination of the point of puncture.

The present invention is intended to overcome the disadvantages of known venous catheter systems and to provide a system in which the risk of air embolies, the risk of buckling of the catheter and the risk of contaminationaat the point of puncture is eliminated or essentially reduced. In the present system a venous pressure meter and one, two or more infusion medium supplies may be connected simultaneously thanks to a particular arrangement. The invention is based on the idea that all adjustable connection means are removed from the point of puncture. Accordingly the apparatus of the invention for safe puncturing of a central vein comprises a

flexible catheter of thin material having at one end a tip and at the other end a one-way valve connected thereto, a flexible extension tube having a first end and a second end, the first end thereof sealingly connectible to the other end of the catheter and the one-way valve, a multiway-valve connected to the second end of the flexible tube and including connections for venous pressure, injection syringe means and dropping supply means, a retractable cannula connectible to the other end of the catheter through the one-way valve in lieu of said extension tube and capable of extending through the one-way valve and the catheter and having a tip portion for projecting from the tip of the catheter, and a venous pressure meter connected to the venous pressure connection of the multiway-valve.

Further characteristics will be evident from the following detailed description in which will be referred to the accompanying drawings. In the drawings Figure 1 is diagrammatically showing the apparatus according to the invention connected to a patient lying in a bed, whereby two infusion mediums and a venous pressure meter are connected simultaneously to the venous catheter system. Figure 2 is showing more in detail a simple embodiment of the invention, in which a venous pressure meter and an injection syringe are connected simultaneously to the venous catheter system. Figure 3 is showing the venous catheter with the cannula introduced therein, and the Figure is illustrating the method of puncturing a vein. Figure 4 is showing an embodiment of the venous catheter system ac ording to the invention having the possibility of connecting several infusion or measuring means.

The apparatus according to the invention generally comprises a valve catheter 1 having a flexible extension tube 2, in the outer end of said extension tube 2 a connection means 3 for one or more drop bottles (vitrum guttificans) and a venous pressure meter 5 connected to the connection means 3. The valve catherer is applied thrcugh vena subclavia just under the collarbone, and the purpose of applying the central venous catheter is to continuously or intermitently gauge the central venous pressure, to supply large amounts of liquids, to supply liquid during long periods or to frequently take venous samples. As pointed out above there is a sub-pressure in vena subclavia, and therefore it is a risk that air may be sucked into the said vein in connection to the punction and application of the catheter or adjustment or substitution of connection parts adjacent the valve catheter. There is also a risk that the catheter is buckled if changes of connections are frequently made in connection means on the valve catheter. For this reason and

for avoiding a too close contact with the point of punction and the following risk of infection the valve catheter according to the invention is formed with the flexible extension tube 2, which at one end is connected in sealed relationship to the connection hose 7 of the valve catheter for instance by means of an aperture cone and tap cone lock. A preferred embodiment of such an aperture cone and tap cone lock is the so called LUER-LOCK* connection 8 which is usual in this connection. The extension tube 2 is in the other end thereof provided with a several-way cock for instance a three-way cock 9 having two connections 10 and 11, for a venous pressure meter 5, an infusion device or an injection syringe 12 for direct injection through the extension tube and the catheter 1.

As best evident from Figure 3 the valve catheter comprises a one-way-valve 13 having a connection 14 of the LUER-LOCK type and an outlet connection 15 in which a catheter 16 of a thin and flexible material is fixed mounted in sealed relationship. In the usual way the valve is formed with attachment wings 17 by means of which the valve may be attached directly to the patient. A cannula 18 extends through the valve and through the catheter and with the tip 19 thereof it projects somewhat out of the catheter 16. The valve 13 is of usual tap-valve-type, and the valve tap is formed with a handle in the form of two wings 20 indicating the flow direction through the valve tap. In the position shown in Figure 3 the valve is open, whereby the cannula 18 extends straight through the valve tap, and when the cannula is withdrawn from the catheter 16 there may be a flow through the valve catheter. This position is the normal position in case of infusion or gauging the venous pressure. The attachment wings 17 of the valve catheter are attached by means of tape or similar 21 directly to the patient.

*trade mark

The flexible extension tube 2 may be of any suitable material which is flexible and resistant against the stresses which may occur. At one end it is formed with connection means of LUER-LOCK type for sealing and locking engagement with the connection 7 of the valve catheter. In the other end the extension tube 2 has a three-way-valve 9 forming a unit with the remaing parts. The three-way-valve 9 is likewise of the tap-valve type, where the tap handle is indicating the flow direction through the valve. At one connection 10 the venous pressure meter 5 is connected over a pressure conduit 23 which at both ends have connection means 24 and 25 of the LUER-LOCK type. The venous pressure means 5 may if this is found suitable in the bottom be provided with a further three-way-valve 26 of the same type as the cock 9, and the meter is in the conventional way formed as an open and graduated type 27 having an attachment clamp by means of which the pipe 27 may be attached in any suitable place and on correct vertical level in relation to the patient. Normally the venous pressure meter is located with the zero-point thereof located on the same horizontal level as the centre of the heart of the patient. As indicated in Figure 2 an injection syringe 12 may be connected to the other connection 11 of the three-way-cock 9 for direct injection through the cock 9, the extension tube 2 and the valve catheter 1. In such a case the cock handle 22 is normally adjusted so that the intermediate handle pin points to the left in which case the valve pressure meter is disconnected. Otherwise there will be a risk that the infusion medium is forced into the venous pressure meter.

In the embodiment shown in Figure 4 a three-way-valve 29 of substantially the same type as the valve 9 but having an aperture cone connection means 30 is connected to the connection 11, and to one connection 31 of the said second threey-way-valve 29 a dropping bottle 4 is connected over the flexible tube 32.

If there is a need of injecting two different mediums simultaneously means for supplying the second medium may be connected to the free connection 33 of the second three way valve 29 or an injection syringe may be applied in the same way as shown in Figure 2. If the free connection 33 is not used a protection cover 34 is screwed on for preventing penetration of air and/or contamination thereof. Also the additional three-way-valve 29 is formed with a three-armed handle 35 indicating the flow direction through the valve. From Figure 4 is also evident that the venous pressure meter pipe 27 is formed with a clip 36 which may be moved along the pipe for marking the latest venous pressure that has been measured.

It is of great importance that the zero-point of the venous pressure meter is correctly adjusted in relation to the patient or the heart of the patient, and for this purpose the venous pressure meter may have a sight means for facilitating the adjustment of the zero-point thereof to correct vertical level in relation to the patient. The sight means 39 may as diagrammatically shown in Figure 2 be formed with a water level 40 for correct horizontal adjustment of the sight means and a following correct vertical positioning of the venous pressure meter. The sight means 37 may be a mechanical device or it may be an electric lamp ejecting a narrow beam so that the pressure meter may with great accuricy be correctly positioned in the vertical direction.

When applying the central venous catheter it is acted as follows: A usual injection syringe 37 containing some suitable liquid is connected to the valve catheter 1 and the cannula 18 is filled with this liquid, whereupon vena subclavia is punctured at the point 6. At the same time as the vein is punctured blood is aspirated through the cannula 18 into the syringe 19 so as

to prevent introduction of air what may otherwise occur due to the subpressure in the vein. While still aspirating the cannula needle is withdrawn, and when the needle tip is passing the valve 13 this is closed by turning the handle 20 90°. The cannula 18 is completely withdrawn, and instead thereof the flexible extention tube 2 is connected by means of the lock connection 8, the venous pressure meter 5 is connected by means of the lock connection 24 and one or more dropping bottles 4 may be connected over the connection 11 or 31 and 33 respectively. The venous pressure meter 5 is adjusted to correct vertical position in relation to the patient, and when it is made sure that all air is removed from tubes and connections the zero-point is adjusted in the venous pressure meter what may take place by means of the bottle of liquid connected to the valve 26. When gauging the venous pressure the valve 9 is opened so as to connect the venous pressure meter 5 with the valve catheter 1, and in case the venous pressure meter is provided with the valve 26 this is also opened as indicated in Figure 2. The venous pressure meter will thereby continuously give the pressure of the vein. If now it is wished to introduce some liquid to the patient the venous pressure meter is disconnected by the valve 9 as indicated in Figure 4 and the valve 29 is opened so that there will be a flow from the dropping bottle 4 into the patient over the valve catheter 1.

As indicated in Figure 1 the connection means 3 is located on an essential lower level than the valve catheter 1, and by this the subpressure existing in the vein is compensated. Even if now any false connection or false adjustment of the valves has been made so that the flexible extension tube 2 is opened towards the air this does not however involve any risk to the patient since the subpressure in the vein is compensated. Depending on what action is wished the valves 9 and 29 are adjusted while the valve 13 is on the

contrary kept open until it is wished to remove the central venous catheter. Since the venous pressure meter is continuously connected to the catheter system it is possible to check any time and very quickly the venous pressure and thereby to obtain very quickly an indication of the liquid status of the patient and this can be done without the risk of air embolics since the subpressure in vena subclavia is compensated and without risk of buckling of the catheter tube since this is kept fixed by the wings 19 taped against the patient and since there is no need of touching the valve catheter 1 anytime after the connection of the extension tube 2. By the system according to the invention also the risk of infection at the point of function has been reduced since there is no handling close to this point but only in the outer end of the extension tube 2 which with the free end thereof is hanging free from the patient. By forming the valve catheter 1 with a one-way-valve also the risk of false adjustment of the tap and any following penetration of air is prevented.

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. Apparatus for safe puncturing of a central vein such as a vena subclavia, comprising: a flexible catheter of thin material having at one end a tip and at the other end a one-way valve connected thereto, a flexible extension tube having a first end and a second end, the first end thereof sealingly connectible to the other end of the catheter and the one-way valve, a multiway-valve connected to the second end of the flexible tube and including connections for venous pressure, injection syringe means and dropping supply means, a retractable cannula connectible to the other end of the catheter through the one-way valve in lieu of said extension tube and capable of extending through the one-way valve and the catheter and having a tip portion for projecting from the tip of the catheter, and a venous pressure meter connected to the venous pressure connection of said multiway-valve.

2. Apparatus as set forth in claim 1, in which the connection between the flexible extension tube and the one way valve and catheter is a sealing lock connection of aperture cone and tap cone type.

3. Apparatus as set forth in claim 1, in which the venous pressure meter comprises a graduated pipe including a multiway-valve mounted in the bottom thereof, wherein said last noted valve may be connected to a bottle for filling and calibrating the venous pressure meter.

4. Apparatus as set forth in claim 3, in which the venous pressure meter is constructed to be vertically displaceable relative to an attachment clamp for vertical adjustment of the graduated pipe in relation to the position of the patient, and further including a displacable clip for indicating the latest measured venous pressure.

5. Apparatus as set forth in claim 4, in which the venous pressure meter comprises means for adjusting the graduated pipe in vertical position in relation to the patient.

6. Apparatus as set forth in claim 5, in which the means for adjusting the graduated pipe comprises a sight and water level means for adjusting the horizontal position of the sight.

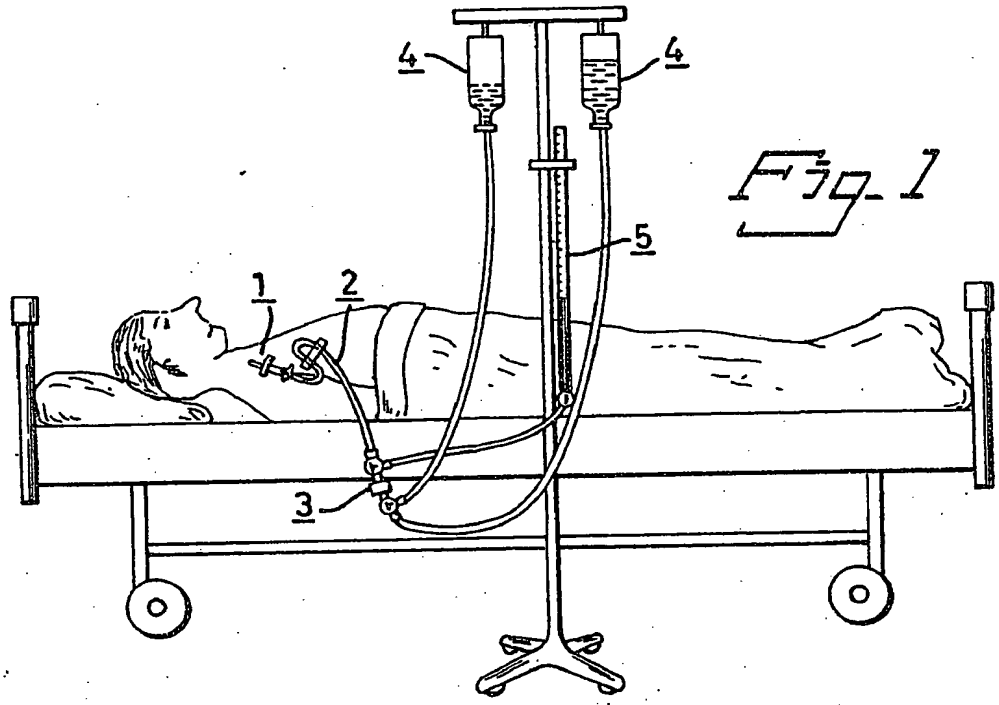

Fig. 1

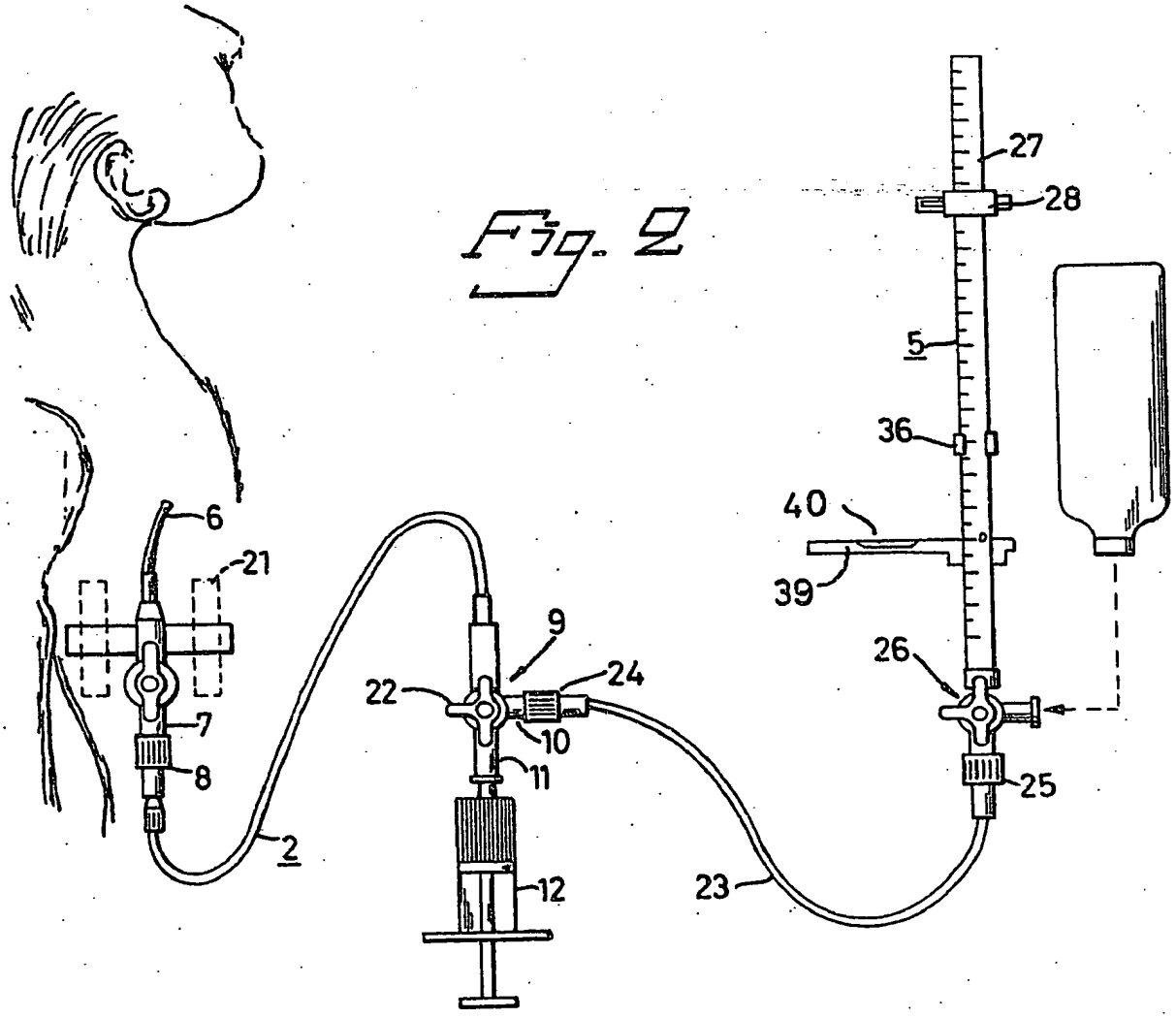

Fig. 2

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Fig. 3

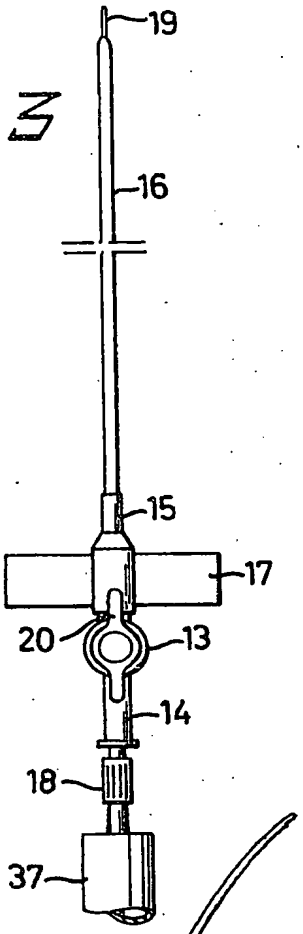
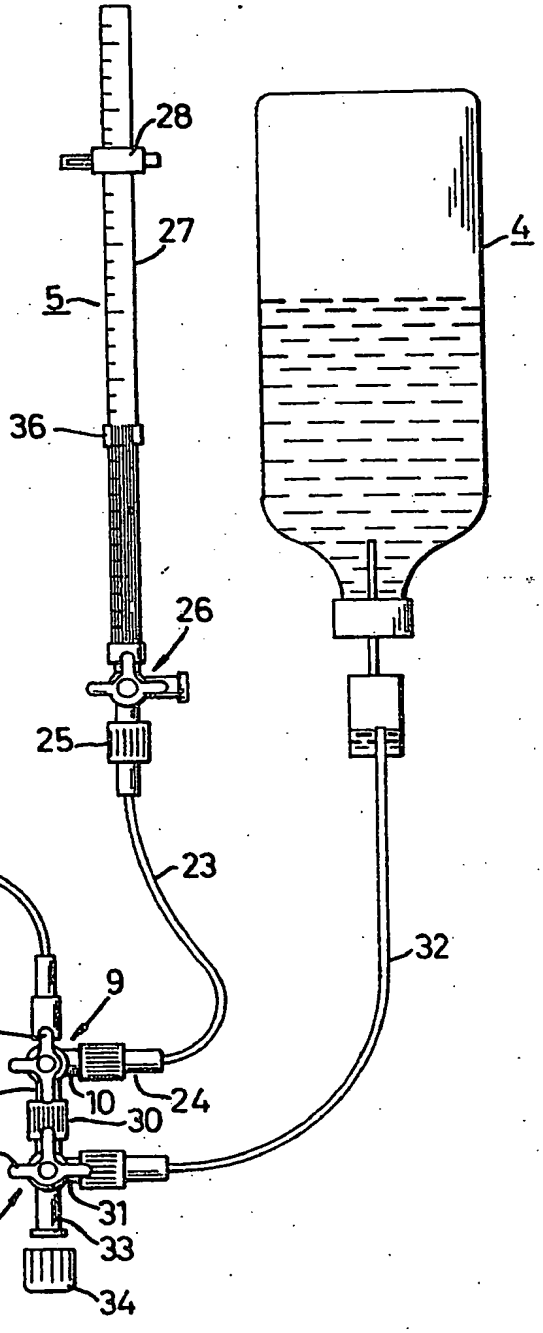


Fig. 4



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